



Date: July 23, 1982

Subject: Primary Processes R & D
Monthly Report - July 1982

From/Location: E. L. Cambridge

To/Location: J. G. Kaufman

BASIC RESOURCES RESEARCH

Alumina Testing and Evaluation

Alumina samples have been received from Sebree and Alpart and requested from Columbia Falls. Equipment is available to measure apparent density, angle of repose, packing density, screen analysis and BET surface area. The apparatus for measuring the attrition index is being constructed by Cal Glass, Inc. Analytical facilities are available for impurity analysis, LOI, free moisture and percent γ and α - Al_2O_3 .

AD-118 Fluoride Catalyzed Leach of Clay

The final report "Fluoride Ion Activation of Clay" by D. M. Blake was issued. Fluoride ion additions do activate clay for HCl leaching (as an alternative to calcining), but 40 percent of the fluoride is lost with the tails making this an uneconomical option.

AD-120 Anaconda AlCl_3 Process

a. ACH Calcination

It has been established that ACH source has a significant effect on chlorination behavior. Partially calcined clay-derived material ACH provides better chlorination rates than commercially available synthetic ACH. However, by recrystallizing the synthetic material from a liquor containing impurity levels equivalent to the sparging crystallizer feed in the USBM work, we can make synthetic ACH equivalent to clay-derived material. Therefore, we are now constructing a 10 kg capacity lab-scale sparging crystallizer and a continuous-feed rotary kiln to manufacture uniform ACH samples for continuing chlorination work. This obviates the need for a small scale pilot plant to produce clay-derived ACH for further lab studies.

b. Reductant Studies

Experimentation continued to identify the most promising reductant. Solid reductants offer the greatest economic advantage if treatment results in good relative chlorination kinetics.

Various calcination and acid-melt activation experiments are being performed to determine a treatment to provide a coke with low residual

hydrogen to minimize chlorine loss, and high surface area to enhance reaction kinetics.

Experimental runs using producer gas (a low cost source of CO) and pure CO as reductants gave the same relative chlorination rates. However, a material balance on chlorine indicates a much higher chlorine consumption with producer gas, as the residual hydrogen combines almost stoichiometrically with the chlorine. No further work is planned with a producer gas reductant.

c. Other

The following two patent applications were forwarded to the U.S. Patent Office:

"Aluminum Production via the Chlorination of Aluminum Chloride Hexahydrate (ACH)" by E. L. Cambridge, R. O. Loutfy, and J. C. Withers,

"A Method of Producing Anhydrous Aluminum Chloride from Acid Leach-Derived ACH" by R. O. Loutfy, and J. C. Withers.

Alumina Related Chemicals

A preliminary investigation was undertaken to:

- o Develop a characteristics sheet on each of the major alumina chemicals and refractories products.
- o Design a product evaluation methodology.
- o Recommend a strategy to identify opportunities in alumina chemicals and refractories.

A draft report is being prepared.

REDUCTION RESEARCH

AD-108 Process

Cell material balance studies are continuing to identify electrolyte composition changes/losses with time, and determine the optimal composition.

Experiments to optimize prebaked composite anode formulation with respect to density, porosity, mechanical strength and resistivity are in progress.

5/8 inch diameter composite anodes were successfully made using coal-tar pitch instead of pitch-phenolic as a binder and carbon source. Coal-tar pitch is less expensive and more abundant than phenolic.

AD-116 Potlining Resource Recovery

A final joint pre-phase I potlining recovery report has been agreed upon by both parties and will be issued by the end of July. In the report, both Anaconda and Alcan recommend that a phase I study be undertaken to develop a single process flowsheet with the unit operations process parameters verified (either in our laboratories or in vendor laboratories). Approximately six man-years and \$150 M would be required to complete Phase I.

Petroleum Pitch

Twenty gallons of Ashland pitch is scheduled to be delivered to Tucson for the planned evaluation of this material.

DEVELOPMENT AND TECHNICAL SERVICES

Pot Magnetics

The bus modification was completed on pot 304 in early July. So far, the metal pad has been reduced one inch and the set-point voltage has been reduced 100 millivolts. The current through each flex will be measured this week to determine the overall current distribution. The shield for the magnetics probe is being redesigned to prevent hot spots on the top portion of the shield. Magnetic probe data is expected within a month. The plan is to convert the bus on pot 305 during the first part of October.

Lithium Fluoride

Concentration of LiF has leveled to 1.3 percent and bath temperatures have declined to 970° in the test cells at Columbia Falls. Other operating parameters are satisfactory. The target is 2.0 percent LiF.

Columbia Falls Anode Formulation Optimization

Arco coke samples have been screened in preparation for the vibrated bulk density determinations which will be accomplished in the next four to five weeks. The general strategy is to complete the work on Arco coke and at that time, decide whether or not to proceed with Collier coke.

Sebree Anode Formulation Optimization

The first planning meeting was held on the this project. We plan to begin laboratory work using Gulf coke in November.

Continuous Pot Temperature Measurement

A project proposal for continuous pot temperature measurement was issued and accepted by both plants. Paul Russell will coordinate the project for Tucson, while Karen Uebelhack and Gordon Saurey will lead the project at Sebree and Columbia Falls.

Paul Russell has been in contact with Dr. Malcolm Washburn of the Norton Company. Dr. Washburn has performed many corrosion studies of various nitride and boride materials in cryolite melts. A list of the materials and their rate of attack gleaned from him is shown below.

<u>Material</u>	<u>Corrosion Rate (inches/year)</u>
AlN (hot pressed)	120
Sialon	30
Si ₂ ON ₂	25
TiB ₂	16
Si ₃ N ₄ * (reaction bonded)	5
(hot pressed)	7
*Salt migration is very high	

Dr. Washburn has also studied many of the proposed inert anode materials with none having better corrosion ratios than the last three materials above. He feels that a corrosion rate of less than 2 inches per year must be obtained for any material to be economical and practical. Dr. Washburn suggests a double sheath concept with an outer layer of Si₃N₄ and an inner layer of Si₂ON₂.

Raouf Loutfy has suggested that we take a look at laser annealing for sealing the outer surface of Si₃N₄ tubes to prevent salt migration. We plan to pursue this idea.

Sebree Large Anode Project

Sebree received authorization to proceed with Phase II of their large anode project. The plan is to begin pressing during the first week in August and to have twenty pots converted by mid-November. Subodh Das will visit Sebree for two weeks beginning August 16 to help establish plans for developing the project data base.

Techno-Economic Model

Sebree has requested that Tucson assist in developing a general techno-economic model for their plant. A project definition and organization meeting will be held at Sebree on August 25. Subodh Das will be leading the project and will be coordinating with W. R. Henning, Administrative Manager at Sebree.

High Conductivity Cathode Block for Sebree

A project to investigate the feasibility of using high conductivity cathode block in the pots at Sebree was initiated. The stated objective is to reduce the cathode voltage drop by at least 30 percent while maintaining the life of the cell. The project will focus on (1) the selection of candidate materials and supplies, (2) the economic payback achievable, and (3) the necessary changes in the cathode lining to maintain the proper thermal profile. A project definition and scope is forthcoming.

Reduction Technical Workshop

Paul Russell will be coordinating a technical workshop with the process engineers at each plant and the reduction R & D group to present information on some of the developmental projects ongoing at each location, and to exchange general technical information and ideas. The tentative date for the workshop is September 22-23 at Sebree in conjunction with the Anode Technology Committee Meeting scheduled two days earlier in Louisville.

Technical Assistance

1. Contacted D. Perkins and K. Uebelhack concerning the possible application of a portable low-resistance ohmmeter to check collector bar flex welds and/or collector bar castings before a pot is on-line. The James G. Biddle Company is receptive to a trial of their equipment at the plant.
2. Discussed with Gordon Saurey the possibility of electrically insulating out the anode skirts to increase their service life and decrease iron contamination in the metal based on a study conducted by the University of Norway. A copy of the University of Norway article was sent to Gordie and Dave Krause at Columbia Falls.
3. Discussed with Poor and Poertner baking techniques for the large test anodes at Sebree. We recommended trying pit covers for raising the bake zone.

Alumina Meter


Dr. Nolan Richards of Reynolds at Lister Hill was contacted concerning our purchasing their meter for continuous determination of alumina in bath. As soon as he can get authorization to proceed, he will communicate costs and schedules.

PERSONNEL

R. F. (Bert) Bell transferred from Louisville to our Alumina and Chemicals group as a Staff Research Engineer, effective July 5.

E. D. (Ed) Creamer, formerly at Argonne National Laboratory joined the Reduction group as a Staff Research Engineer, effective July 12.

K. R. (Kirk) Weisbrod transferred from Arco Coal, Plano to our Carbon and Materials group as a Senior Research Engineer, effective July 12.


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